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Application Note

***EBI* Track 200 TI21** Use of Compensating Capacitors

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1 INTRODUCTION

This Application Note summarises the application of 'capacitor compensation' to *EBI* Track 200 Track Circuits which have sustained low ballast resistance and is supplemental to the *EBI* Track 200 Technical Manual M125401A4 [1].

2 REVISION HISTORY

Issue					
From	To	Date	Reason for Change	ECR No	Sig.
-	0.1	16/08/12	Draft for review	-	CM
0.1	0.2	25/09/12	Second draft	-	CM
0.2	1	31/10/12	Formal release after review by Network Rail.	6-43293	AM

3 TERMINOLOGY

BT	Bombardier Transportation
Drop-Away	Drop-away Time The time between the application of a shunt to the rails and the front contacts of track relay (TR) fully opening (see also Pick-up Time).
Drop Shunt	The maximum value of resistance which, when placed across the rails at the relay end of a Track Circuit will cause the Relay to de-energise (that is, just break its front contacts).
<i>EBI</i> Track 200	Bombardier brand name for the TI21 audio frequency track circuit
Local Resonance	A change in resonance at a particular point along the track circuit due to the presence of a local inductance or capacitance.
NR	Network Rail
Prevent Shunt	The prevent shunt of a Track Circuit is the value of resistance connected across the rails at which the track circuit Relay energises (that is, it just makes its front contacts). Pick-up Shunt The minimum value of resistance between the two running rails at which the track relay will just close its front contacts.
Rail Voltage	The level of voltage produced by the track circuit equipment as measured between the two running rails. For audio frequency track circuits, this voltage decreases significantly between the transmitter and receiver end due to the impedance of the rails.
Rx	Receiver
TR	Track Relay
TTM	TI21 Test Meter
TU	Tuning Unit
Tx	Transmitter
WSF	Wrong Side Failure

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4 Technical Risks

The technical risks associated with this modification are:

1. The Drop Shunt maintained in dry weather will be reduced:
 - This cannot be avoided in conditions of sub-standard ballast resistance.
 - The reduction in Drop Shunt will be accompanied by an increase in Rail Voltage which will mean that the quality of Train Detection will be maintained.
 - The Drop Shunt will not go below the 0.3Ω .
2. Resonant effects of the Capacitors leading to unstable Energisation and Drop Shunt:
 - This is closely tested for each site.
 - No problems have been found at the sites previously modified.
3. The capacitors are rated to 250V. Traction shorts/tripping may cause degradation of capacitance leading to a drop in track circuit current and subsequent unreliability of the track circuit.

5 Risk Mitigation

The Testing Requirements in section 9 will mitigate all risks at the time of installation. The continued risk while this modification is in use must be monitored. This must be managed in the following way.

- Digital Rx solution.
With the *EBI* Track 200 Digital Rx it is feasible to connect a data logger to the track circuit in order to provide remote monitoring of the track circuit performance. If such a logging system is implemented, with the following alarms actively monitored, then there is no requirement to change the service interval. If logging cannot be implemented, then proceed as for analogue Rx.
 - o Logger active signal not present.
 - o Clear track current excessively high.
 - o Clear track current too low.
 - o Occupied Current high.
 - o In the event of an alarm alert being received, corrective action must be taken as described in section 5.1 below.
- Analogue Rx solution
With the TI21 analogue Rx, continuous monitoring is not possible, so the following controls are required.
 - o The routine maintenance interval described in section 6 of the Technical Manual [1] shall be no more than 26 weeks.
 - o In order to closely monitor changes in ballast resistance, the voltage across the Rx 1Ω resistor shall be measured every 28 days and compared to the previous reading. If the reading is not within 10% of previous reading then corrective action must be taken as described in section 5.1 below.

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5.1 Corrective Action

Corrective action may be required for one of two reasons:

- The track circuit current has fallen – this leads to a reliability hazard..
- The track circuit current has increased – this leads to a wrong side failure safety risk.

Low Current

Standard fault finding techniques, as described in section 6.4 of [1] shall be deployed in order to discover the cause. Note that an additional cause of low current could be degradation of a Compensating Capacitor after a traction short / tripping.

High Current

An increase in track circuit current indicates that the ballast condition has improved since the track circuit was commissioned. It is essential that the track is re-commissioned as soon as possible in order to mitigate the WSF risk. Re-commissioning will increase the Rx threshold level and restore the safety margin.

6 Design Requirements

The following design requirements are applicable to this modification:

6.1 Capacitor Type

The Capacitors are 20μF for all the *EBI* Track 200 operating frequencies. Bombardier Part No. 520057738.

6.2 Capacitor Connection

A Capacitor is to be connected at nominal distances of 100m and 300m from the Transmitter of the *EBI* Track 200 track circuit. The actual installation distance may be +/- 10m from the nominal distance.

6.3 Capacitor Mounting Arrangements

The Capacitors are designed to be bolted directly to the rails.

6.4 Restrictions

Capacitors must not be placed within 100 m. of Impedance Bonds